

# Stator with a Radial Winding and Method for Manufacturing Same

## Background of the Invention

### 1. Field of the Invention

The present invention relates to a stator with a radial winding and a method for manufacturing such a stator, thereby providing a stator that can be easily manufactured and that has a larger rotating torque.

### 2. Description of the Related Art

Fig. 1 of the drawings illustrates a stator with a conventional radial winding. The stator comprises a plurality of silicon-steel plates 90 of identical shape and size and having a central hole 94 for rotatably receiving an axle tube, which, in turn, rotatably receives a shaft (not shown) of a rotor (not shown). Each silicon-steel plate 90 includes even-numbered poles 91 and a pole face 92 is formed by the distal ends of the stacked poles 91 of the silicon-steel plates 90. The poles 91 have a metal wire 93 wound therearound, and the pole faces 92 of the stator and the permanent magnet (not shown) of the rotor induct each other.

In the stator having such a conventional radial winding, each two angularly adjacent poles 93 of the stacked silicon-steel plates 90 have a relatively small gap therebetween, which results in a difficult and touchy winding procedure. If the gap between the pole faces 92 of the respective poles 91 is increased, the inductive surface area between the stator and the rotor is be reduced. As a result, the rotating torque of the rotor is reduced. In addition, the cogging torque is increased, which causes trembling in the rotation of the rotor. Furthermore, in the stator having such a conventional radial winding, if the diameter of the metal wire 93 wound around the poles 91 of the stacked silicon-steel plates 91 is increased for increasing the rotating torque of the rotor, the metal wire 93 wound around the poles 91 tends to be have a friction contact with an end edge of the pole face 92, which damages a layer of paint covering the metal wire 93. Thus, the winding cannot be proceeded easily and the ratio of disqualified products to qualified products is increased. Manufacture of stators with many poles is more difficult in view of the above-mentioned problems.

## Summary of the Invention

It is an object of the present invention to provide a stator with a radial winding and a method for manufacturing such a stator, wherein the winding and manufacture procedure for the stator can be accomplished easily to thereby reduce the cost and expense for manufacture.

It is another object of the present invention to provide a stator with a radial winding and a method for manufacturing such a stator, wherein the winding and manufacture procedure for the stator can be accomplished easily to thereby reduce the ratio of disqualified products to qualified products.

It is a further object of the present invention to provide a stator with a radial winding and a method for manufacturing such a stator, wherein the winding and manufacture procedure for the stator can be accomplished easily and wherein the diameter of the metal wire to be wound around each of the poles of the stator can be increased to thereby increase the rotating torque of the rotor.

It is still another object of present invention to provide a stator with a radial winding and a method for manufacturing such a stator, wherein the inductive area between the stator and the rotor is increased to thereby increase the rotating torque of the rotor.

A stator with a radial winding and a method for manufacturing such a stator in accordance with the present invention provides a plurality of pole plates made of a magnetically conductive material. Each pole plate comprises a hub and at least two poles extending radially outward from the hub. The poles are spaced by an identical angular interval. Each pole has a distal end with a magnetic pole face. A metal wire is wound around the poles of the pole plates, thereby forming a pole plate assembly. At least two of the pole plate assemblies are assembled together with the poles of the pole plate assemblies disposed alternately.

Other objects, specific advantages, and novel features of the invention will become more apparent from the following detailed description and preferable embodiments when taken in conjunction with the accompanying drawings.

### **Brief Description of the Drawings**

Fig. 1 is a perspective view of a stator with a conventional radial winding.

Fig. 2 is an exploded perspective view of a first embodiment of a stator in accordance with the present invention.

Fig. 3 is a perspective view of the stator in Fig. 2.

Fig. 4 is an elevational view of the stator in Fig. 3.

Fig. 5 is an exploded perspective view of a second embodiment of the stator in accordance with the present invention.

Fig. 6 is a perspective view of the stator in Fig. 5.

Fig. 7 is an elevational view of the stator in Fig. 6.

### **Detailed Description of the Preferred Embodiments**

Preferred embodiments in accordance with the present invention will now be described with reference to the accompanying drawings.

Referring to Fig. 2, a first embodiment of a stator in accordance with the present invention generally comprises at least two pole plate assemblies 1 and an engaging member 2 for engaging the pole plate assemblies 1 together.

Each pole plate assembly 1 comprises a plurality of identical silicon-steel plates (pole plates) made of magnetically conductive metallic material. Namely, each pole plate assembly 1 is formed by stacking a plurality of silicon-steel plates of identical size and shape. Each pole plate assembly 1 comprises a central hub 11 having a central hole 12 through which the engaging member 2 extends. The hub 11 includes a plurality of poles 13 extending radially outward therefrom, the poles 13 being spaced by an identical angular interval. When assembling the pole plate assemblies 1 together by the engaging member 2, the poles 13 of one of the pole plate assemblies 1 are respectively placed in the spaces between the poles of the other pole plate assembly 1 such that the poles 13 of one of the pole plate assemblies 1 and the poles 13 of the other pole plate assembly 1 are alternatively disposed.

1 A magnetic pole face 14 is formed on a distal end of each pole 13. In a preferred  
2 embodiment of the invention, one or two of the magnetic pole faces 14 are extended along a  
3 vertical direction to thereby form a larger inductive face 15. In addition, in order to start the  
4 rotor more easily, the two ends of the inductive face 15 are provided with asymmetric portions  
5 16 by means of providing a chamfered edge and an inclined shoulder on an end of the  
6 inductive face 15, or by providing the two ends of the inductive face 15 with different  
7 thicknesses. Thus, when the permanent magnet (not shown) of the rotor (not shown) and the  
8 inductive face 15 of the stator induce each other, the rotor can be started easily.

9 A metal wire 17 can easily be wound around the poles 13 of the pole assembly 1 to the  
10 required turns according to the positions of the poles 13. During the winding procedure, the  
11 metal wire 17 is provided with a larger space for winding, which means that damage to the  
12 metal wire 17 is prevented and that a metal wire of a larger diameter can be used in winding.

13 The engaging member 2 assembles the at least two pole plate assemblies 1 together. In  
14 the preferred embodiment, the engaging member 2 can be in fitting engagement with the  
15 central holes 12 of the pole plate assemblies 1, and the poles 13 of the pole plate assemblies 1  
16 are spaced by an identical angular interval about the center of the engaging member 2.  
17 Alternatively, as illustrated in Fig. 2, the engaging member 2 may include a plurality of  
18 grooves 21 that are spaced by an identical angular interval. An inner periphery defining the  
19 central hole 12 of each pole plate assembly 1 has a plurality of aligned grooves 18 that are  
20 spaced by an identical angular interval and that face the grooves 21 of the engaging member 2,  
21 respectively. A pin 22 is inserted into the grooves 18 and 21 to thereby secure the engaging  
22 member 2 and the hubs 11 of the pole plate assemblies 1 together. In another embodiment, the  
23 engaging member 2 may include a plurality of grooves or ribs that are spaced by an identical  
24 angular interval. The inner periphery of the central hole 12 of each pole plate assembly 1 has a  
25 plurality of ribs or grooves that are spaced by an identical angular interval and that engage  
26 with the grooves or ribs of the engaging member 2, respectively. The engaging member 2 may  
27 further include a flange 23 on an end thereof for preventing disengagement of the pole plate

assemblies 1. The engaging member 2 further include a central hole 24 into which a bearing (not shown) is mounted for rotatably receiving a shaft (not shown) of the rotor.

Referring to Figs. 3 and 4, in a method for manufacturing the stator having the above-mentioned structure in accordance with the present invention, a metal wire 17 is wound around the poles 13 of each pole plate assembly 1 to the required turns, and the terminals of the metal wire 17 are connected to a power source. After each of the pole plate assemblies 1 have been wound by the metal wire 17, the central holes 12 of the pole plate assemblies 1 are aligned with each other, whereas the poles 13 of the pole plate assemblies 1 are spaced by an identical annular interval. The engaging member 2 is then extended through the aligned central holes 12. Thus, the engaging member 2 and the pole plate assemblies 1 are securely engaged together to form a stator with a radial winding.

Fig. 5 illustrates a second embodiment of the stator in accordance with the present invention, wherein the stator comprises at least two pole plate assemblies 1 and an engaging member 2. Each pole plate assembly 1 comprises a plurality of silicon-steel plates of identical shape and size. Each pole plate assembly 1 comprises a hub 11 from which four poles 13 extend radially outward, the poles 13 being angularly spaced by 90 degrees. A metal wire 17 is wound around the poles 13 of the stacked silicon-steel plates. A magnetic pole face 14 is formed on a distal end of each pole 13. The magnetic pole face 14 may extend vertically to form an inductive face 15. Thus, each pole plate assembly 1 has a larger inductive area. In addition, the inductive face 15 may include two asymmetric ends 16 identical to those in the above embodiment.

Referring to Figs. 6 and 7, when the poles 13 of the pole plate assemblies 1 are spaced by an identical annular interval after engagement of the pole plate assemblies 1, the engaging member 2 is then extended through the aligned central holes 12. Thus, the engaging member 2 and the pole plate assemblies 1 are securely engaged together to form a stator with a radial winding.

1 In accordance with the stator with a radial winding and the method for manufacturing  
2 such a stator of the present invention, the poles 13 of each pole plate assembly 1 of the stator  
3 are separately wound by the metal wire 17 and the pole plate assemblies 1 are then engaged  
4 together by the engaging member 2 with the poles 13 of the pole plate assemblies alternately  
5 disposed and spaced by an identical angular interval. The angle between two adjacent poles 13  
6 of each pole plate assembly 1 before the assembling procedure is relatively large, which  
7 allows easy winding while eliminating the risk of damage to the metal wire 17. The stator thus  
8 manufactured has a low cost, and expense and the ratio of disqualified products to qualified  
9 products is lowered. In addition, the diameter of the metal wire 17 can be increased and the  
10 inductive area of the magnetic pole faces 14 of the stator is increased to thereby increase the  
11 rotating torque and the twisting force of the rotor.

12 Although the invention has been explained in relation to its preferred embodiment as  
13 mentioned above, it is to be understood that many other possible modifications and variations  
14 can be made without departing from the scope of the invention. It is, therefore, contemplated  
15 that the appended claims will cover such modifications and variations that fall within the true  
16 scope of the invention.